

Kofa Mountains Complex Predation Management Plan



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APPROVED: _____

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DATE: _____

Introduction

This management plan has been developed to address mountain lion predation on a depressed desert bighorn sheep population located in the Kofa Mountains Complex of southwest Arizona. This complex includes the Kofa, Castle Dome, New Water, South Plomosa, Tank and Little Horn mountains. The majority of the area under consideration falls within the boundaries of the Kofa National Wildlife Refuge (Kofa NWR). This plan follows the spirit and guidance of the Arizona Game and Fish Commission Predation Management Policy and the Arizona Game and Fish Department Predator Management Team Report.

Specifically, the Arizona Game and Fish Commission Predation Management Policy states:

“Actions by the Arizona Game and Fish Department (department) should be based on the best available scientific information. Mountain lions and coyotes will be managed to ensure their future ecological, intrinsic, scientific, educational, and recreational values, to minimize conflict with humans, and to minimize adverse impacts on other wildlife populations.

The department will develop site-specific management plans when either of these two species is considered to be inhibiting the ability of the Department to attain management goals and objectives for other wildlife species.”

Furthermore, the Department’s Predator Management Team Report states that; “Predators and their prey cannot be managed separately” and that “as a Department we must strive to develop the biological and social data necessary to manage predators with a program that is biologically sound and publicly acceptable.”

Area Description

The project area consists of portions of Game Management Units (GMU) 41, 44BS, and the entirety of GMU 45A, B, and C (Kofa NWR) in the Yuma Region of the Arizona Game and Fish Department. These units cover approximately 1400 square miles in the Basin and Range province of southwestern Arizona. See Appendix 1 for a map of the area under consideration. Topography is generally composed of vertical cliff faces, rugged canyons, mesas, boulder-strewn terrain, rolling hills, and broad alluvial valleys. Elevations range from less than 1,000 feet asl in the King Valley to approximately 4877 feet asl on Signal Peak in the Kofa Mountains. The predominant vegetation type ranges from lower Sonoran Desert Scrub to Chaparral-grassland on the highest peaks.

Statement of Need

For several years, range conditions in the Kofa Mountains Complex have been affected by low rainfall. Rainfall recorded at the Kofa Mine Weather Station for the past 15 years is presented in Appendix 2. From 1995 to 2005 most years posted below average precipitation and 2 years (1996 and 2002) had severe drought. Though calendar year 2002 had 3” of rain, the 12-month period from September 2001 to August 2002 had only 0.8”. This 10-year period of drought has likely had a negative impact on plant communities, water distribution, and animal populations.

The Arizona Game and Fish Department conducts bighorn sheep surveys on a rotational basis every 3 years. Sheep population estimates based on the Kofa Group Size Estimator methodology (Hervert et al.) demonstrate that declines in sheep numbers occurred in the Complex, and especially on the Kofa NWR (GMU 45), following the severe drought years of 1996 and 2002 (Appendix 3). Following the 1996 drought, 2 years of average or above average rainfall preceding the 2000 survey allowed sheep numbers to return to pre-drought levels. However, drought conditions returned in 2002, and a similar

decline was observed in the 2003 survey. Although the area experienced average to above average rainfall in 2004 and 2005, the sheep population did not rebound as it had before, but continued a significant decline. Appendix 4 contains fall sheep survey results for the area under consideration. Appendix 5 contains an explanation of the survey methodology.

Documentation of mountain lions in the area began around 2000, a factor which may help explain continued depressed, even declining, sheep numbers. Mountain lions have historically been only a transient visitor to the Kofa refuge. There are no verified records of mountain lions on the refuge between 1944 and 2001. During a research project conducted in the Kofa Mountains from 1993 through 1996, 50 bighorn sheep were radio collared and 17 mortalities were investigated. None of the 17 could be attributed to lion predation. From 1995-1997, Germaine et al. (2000) conducted surveys for lions in 18 mountain ranges and along the Colorado and Gila Rivers in southwestern Arizona, including the Kofa NWR. They confirmed the presence of only 3 individual lions (in the Mohawk and Growler Mountains) believed to be males, and suggested that a distinct, self-sustaining mountain lion population did not currently exist in southwestern Arizona. They found no evidence of lions on the Kofa NWR.

Beginning in 2004, Kofa NWR staff placed 8 active infrared and 2 passive digital remote cameras at water holes. The refuge documented at least 5 lions on the refuge in 2006. The actual population density is unknown, but photographs of spotted juveniles or females with kittens have been obtained in successive years, suggesting a local breeding population. Little is known about the movement or diet of mountain lions on Kofa NWR. Cache sites have been found containing mule deer, bighorn sheep, and badger. The distinctive tracks of a large male have been observed both on and off the refuge.

Although predation may not be the primary cause of the initial decline in bighorn sheep numbers, the recently established lions have the potential to further depress or inhibit recovery of a sheep herd that is already depressed, particularly on Kofa NWR. Research indicates that mountain lion predation can have significant population-level effects (Hoban 1990, Wehausen 1996, Creeden and Graham 1997, Ross et al. 1997, Rubin et al. 1998, Hayes et al. 2000, Sawyer and Lindzey 2002). Variables influencing mountain lion predation might include relative availability of alternate prey and escape terrain, vulnerability of individual prey, weather, and behavior of individual predators (Leopold and Krausman 1986, Ross et al. 1997, Krausman et al. 1999, Ballard et al. 2001). Declines in the Peninsular and Sierra Nevada populations of bighorn sheep, which are currently listed as endangered by the USFWS, have been attributed, at least in part, to mountain lion depredation (Hayes et al. 2000, Wehausen 1996). Other populations, such as the San Gabriel Mountains herd in California, have declined since 1989 from over 500 animals to less than 90, almost exclusively attributed to mountain lion depredation (Holt et al. 2004). Because a single mountain lion may kill on average one big game animal per week (Anderson and Lindzey 2003), even a small number of lions can inhibit the recovery of the Kofa NWR sheep herd. Five lions have the potential to not only take most recruitment but significant portions of the adult breeding population as well.

We conclude that any amount of predation on bighorn sheep by lions in the Kofa Mountains Complex is significant and represents additive mortality in these GMUs that have already been impacted by drought. Removal of individual lions known to be killing sheep or a reduction in the number of mountain lions in areas where sheep are being killed by lions is deemed necessary to reduce any further sheep population decline and will aid the recovery of the Kofa Mountains Complex bighorn sheep population.

Management Goals, Strategies and Actions

The primary goal of this predation management plan is to aid in the recovery of the Kofa Mountains Complex bighorn sheep population. The goal is to reverse the decline and ensure a population level that can once again support an active bighorn sheep transplant program.

This will be accomplished in part by reducing predation on the bighorn sheep by harvesting mountain lions in the affected area. The strategy will be to remove lions that are known to be killing bighorn sheep or to reduce the number of lions in areas where mountain lions are known to be killing bighorn sheep within the mountain complex formed by the Castle Dome, Kofa, Little Horn, Tank, Plomosa and New Water mountains. Predator control is most effective when problem individuals can be identified and removed (Sawyer and Lindzey 2002). There is evidence that some mountain lions in bighorn sheep habitat may kill multiple sheep within a year, some may kill only one sheep within a year, and some may kill no sheep at all (Ernest et al. 2002). Collaring lions and sheep can provide the necessary data for selective predation management. Tracking individual lions and their kills will allow for the removal of lions that are regularly preying on bighorn sheep as opposed to a less-discriminate landscape removal of lions. Offending lions, defined as one that kills >1 bighorn within a 6 month period would be lethally removed. Lion removal should be accompanied by frequent monitoring of bighorn sheep with surveys and/or collared sheep survival estimates to determine if predator control is achieving the desired protection of bighorn sheep.

Ballard et al. (2001) found several factors common in case studies that dictated when predator reductions were effective and prey populations increased. These factors included:

- Predator control is implemented when the prey populations are below habitat carrying capacity
- Predation is identified as a limiting factor
- Control efforts reduce predator populations enough to yield results (e.g. expected to be approximately 70% of a local predator population.)
- Control efforts are timed to be most effective (just prior to predators or prey reproduction)
- Control takes place at a focused scale (generally <400 mi²).

We believe all of these criteria can be met in the project area. As briefly noted above the best population estimate for the project area is a minimum of 5 lions. This estimate is based on discussions with federal wildlife officials, local mountain lion experts and informal surveys. With an estimated minimum population of 5 mountain lions and a 70% removal rate, it will be necessary to remove 3 to 4 offending lions initially to yield results, according to Ballard (2001).

There are several actions that may be used to reduce mountain lion numbers within the project area. A single lion bag limit for sport hunters has already been authorized for this area outside of the Kofa NWR. Since its inception the single lion bag limit has resulted in the removal of no lions by sport harvest. While this strategy may have potential, its effectiveness is limited. Including the Kofa NWR in the sport hunt has been proposed but like the surrounding hunt area, a sport hunt will probably be ineffective in removing lions. Other measures that could be used to remove mountain lions in the target area include snares, leg-hold and box traps, aerial gunning, shooting, and hunting with the aid of hounds or other approved methods. USDA APHIS - Wildlife Services (Wildlife Services) would be contracted to perform most of the removal. Department employees may also be authorized to remove lions from the management area or direct other individuals to do the removal.

Management actions that can be used in this situation may be limited because of legal constraints. Restrictions listed in Arizona Revised Statutes (A.R.S.) 17-301, preclude the Department from the use of leg-hold traps and snares on public lands other than for research purposes. However, the use of these methods of take can be pursued on private property or on National Wildlife Refuge lands. Live traps (box traps) are being investigated for possible use on public lands. Consultation with Wildlife Services indicates the use of live traps may not be feasible. In addition to the logistics of transporting these traps into remote locations, they have not been proven to be an effective method of capture. If new information or a source of traps becomes available, this method will be evaluated. At certain times of the year (the coolest times of the year), the most effective method of take to achieve predator management is the use of lion hunters employed by Wildlife Services or through a private contractor.

The Region and Department has conducted the following management actions:

- One presentation to the Arizona Desert Bighorn Sheep Society to provide up-to-date information on current status of the bighorn sheep situation.
- Work with the U.S. Bureau of Land Management (BLM) on grazing management actions within the New Water Mountains that may affect forage availability for bighorn sheep. While this has not been documented as occurring within the Kofa Mountains Complex domestic livestock may also act as a buffer species maintaining lion populations at a level higher than the habitat would normally support (Rominger, et al, 2005).
- Work with BLM to implement burro removal efforts to meet burro population levels (AMLs) approved in the Yuma Resource Management Plan.
- Directed sport hunters to the single harvest objective area.
- Work with Kofa National Wildlife Refuge (KNWR) staff to open the Refuge to sport hunting of mountain lions.
- Region IV Staff and lion expert surveyed certain areas for lion sign.
- Maintained water developments and hauled water to all developments in the Kofa Mountains complex not on the Kofa NWR.
- Responded to questions from the public at the “Meet the Commission” forum in January 2007.
- Working with the KNWR staff to prepare an executive briefing on options for the recovery of the Kofa bighorn complex herd.

In addition, the following actions are being considered.

- Springtime surveys to monitor lamb survival and population status.
- Initiate annual sheep surveys on the Kofa NWR.
- Continue our existing action plan process.
- Discussion and possible continuation of research opportunities regarding lion/sheep interaction, and other development impacts to the bighorn sheep population.
- Radio marking and monitoring of bighorn sheep and mountain lions. Kofa NWR has been attempting to place GPS collars on mountain lions since January 2006. AGFD provided additional funding for the capture effort in December 2006.

Intensity and Duration of the Actions

Predator control targeted at offending mountain lions will continue until the sheep population recovers, or until predation by lions is no longer being documented, or no longer limits bighorn sheep population growth. The sheep population will be considered “recovered” when the population approaches the long-term average of 800 sheep, which based on survey data since 1981 is considered the carrying capacity of the refuge. However, the population has fluctuated between 600-800 sheep during times

when no lions were documented on the refuge. As the population recovers to a level between 600-800, no lions should be removed unless there is definitive evidence an offending lion is causing significant mortality. Attaining a population estimate of 800, within a reasonable variation decided by agency personnel, would be reason to cease predator control efforts.

It is difficult to predict how long it will take to meet removal objectives, especially if the use of hounds is not effective. The population targets for the bighorn sheep population discussed above have been established to function as triggers for completion of this project. A secondary goal of removing 3 to 4 offending lions or lions in areas where lions are known to be killing bighorn sheep during one calendar year within the project area through the use of contract services and/or sport harvest will serve as a secondary trigger for completion of this project. However, if lion depredation on bighorn sheep continues to be observed or documented in the project area, the use of contract services to remove additional offending lions or lions in areas where lions are known to be killing bighorn sheep may continue.

Measurable Objectives

Measurable objectives include recovery of the bighorn sheep population within the project area based on population parameters, and the number of lions removed during the project. Both of these objectives will be monitored. Sheep surveys will be conducted in the fall to monitor population parameters. Kofa NWR will be used to monitor recovery of the bighorn population as it lies in the center of the project area and has experienced the largest decline in sheep population to date. The first objective involves an indication that the sheep population on Kofa NWR has recovered to long-term average levels, which is estimated around 800 sheep. Sheep surveys on the Kofa NWR should be done annually to better estimate any progress made as a result of removing offending lions. This effort will depend on securing additional funds to conduct annual rather than tri-annual helicopter surveys. The second objective is the removal of 3 to 4 mountain lions (70% of the estimated population) within the Kofa Mountains Complex. The Department will monitor lion removal by continuing the use of mandatory lion hunter checkout and contract services reporting.

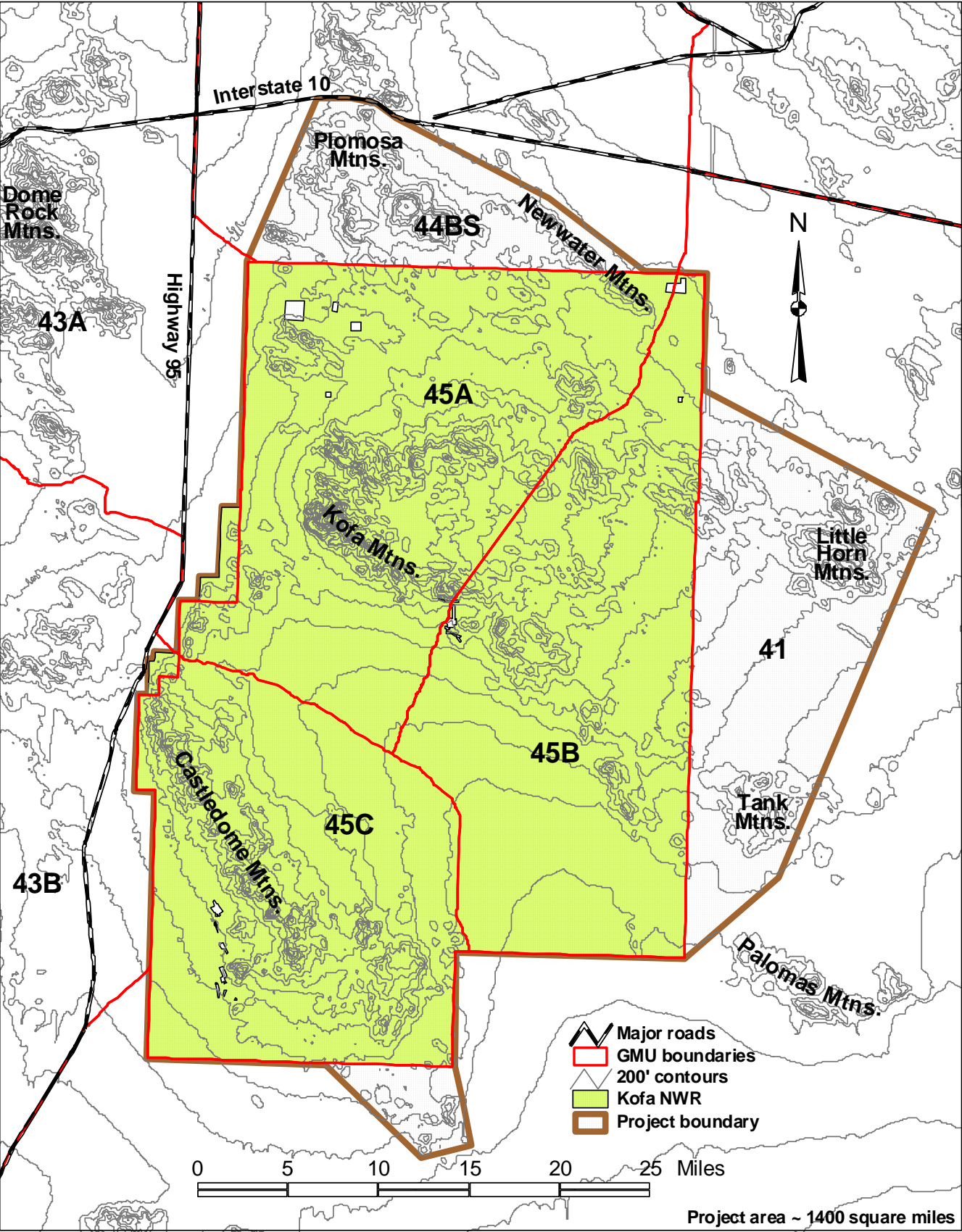
Outreach Plan

Routine public information coordination for this plan will include the Public Information Officers (PIOs) of Region IV, the Information & Education Division (IED) of the AZGFD in Phoenix, the Kofa National Wildlife Refuge (NWR), Region 2 Headquarters of the U.S. Fish & Wildlife Service (USFWS) in Albuquerque, the Yuma Field Office of the Bureau of Land Management (BLM), and the Yuma Proving Ground (YPG).

- Upon approval, a jointly coordinated news release including all the affected PIOs will be released to local (Region IV) media by the Region IV PIO, who will also coordinate for information about the plan to be posted on the AZGFD website.
- A talking point paper for use by AZGFD customer service front counter staff should be prepared. The purpose of the paper will be to equip front counter staffs to answer the bulk of routine customer questions about the plan.
- It should be anticipated that the federal agencies involved, in accordance with their own internal policies, will make their own releases and website postings.
- A public meeting to present the plan should be held at the Region IV office in Yuma. Ideally, the date for this meeting should be noted in the initial press release and on the website posting.
- The Department will consider all requests from the public for presentations on the plan. Such requests should be considered likely.

- Given the somewhat emotional nature of the reaction to predator management in the southwest, we should expect follow-up media interest for some months (or years) following the initial launch of the plan. To the extent this is driven by individuals or organizations opposed to predator management, we should expect the initial tone of such media queries to be negative.
- Absent contrary guidance from IED, any media queries on the plan received by AZGFD should be forwarded to the Region IV PIO.
- We should seek opportunities to periodically publicly highlight progress in the execution of this plan through press releases, media field visits, and other appropriate information venues.
- For specific events where public notification is required or recommended, only those agencies directly affected will be required coordination contacts for information release.

Appendix 1. Map of the Kofa Mountains Complex



Appendix 2. Monthly precipitation data from the Western Regional Climate Center for the Kofa Mine from 1990 to 2005. Annual average is 6.9” (n = 54 years).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
1990	0.88	0.18	0.11	0.10	0.14	0.00	0.55	1.41	2.99	0.15	0.04	0.09	6.64
1991	0.58	0.44	1.58	0.00	0.00	0.00	0.08	1.04	0.48	0.19	0.17	0.26	4.82
1992	1.16	2.05	2.56	0.27	0.62	0.00	0.06	0.73	0.00	0.38	0.00	2.49	10.32
1993	4.51	3.06	0.44	0.00	0.10	0.00	0.00	0.99	0.02	0.60	0.71	0.00	10.43
1994	0.07	0.83	1.45	0.07	1.57	0.00	0.63	0.96	0.96	0.09	0.15	1.28	8.06
1995	1.90	1.28	0.45	0.80	0.00	0.03	0.65	0.46	0.05	0.00	0.04	0.00	5.66
1996	0.00	0.16	0.01	0.00	0.00	0.00	0.06	1.54	0.10	0.05	0.01	0.01	1.94
1997	0.99	0.04	0.00	0.33	0.05	0.05	0.89	0.54	3.16	0.00	0.07	2.73	8.85
1998	0.43	3.38	0.47	0.02	0.06	0.00z	1.26	0.28	0.75	0.00	0.75	0.39	7.79
1999	0.16	0.77	0.05	0.85	0.00	0.17	1.19	0.18	0.44	0.00	0.00	0.00	3.81
2000	0.04	0.28	0.64	0.00	0.00	0.15	0.00	0.54	0.00	2.37	0.20	0.00	4.22
2001	1.01	0.85	0.73	0.06	0.00	0.04	0.76	1.15	0.05	0.08	0.10	0.39	5.22
2002	0.00	0.00	0.03	0.01	0.00	0.00	0.16	0.00	2.73	0.14	0.13	0.04	3.24
2003	0.67	1.61	0.74	0.05	0.00	0.00	0.60	1.22	0.22	0.00	0.85	0.08	6.04
2004	0.43	0.53	0.54	0.15	0.00	0.00	0.09	0.92	0.19	3.20	3.48	1.75	11.28
2005	1.65	3.46	0.30	0.39	0.00	0.00	1.05	2.72	0.00z	0.95	0.00	0.00	10.52

Appendix 3. GMU 40BW, 43B, 44BS, 41W, and 45ABC bighorn population estimates for 1993 through 2006. Arizona Game and Fish Department – Region IV, Yuma.

	40BW (Gila Mts)	43B	44BS	41W	45ABC (Kofa NWR)
1993			116		
1994	77			93	811
1995		209			
1996			102		
1997	71			108	600
1998		207			
1999			116		
2000	69			107	812
2001		190			
2002			123		
2003				119	620
2004		250			
2005			71		
2006	100			101	390

Population estimates of bighorn sheep on the Kofa NWR (Unit 45) and surrounding hunt units. Data are derived from standardized aerial (helicopter) surveys.

Appendix 4. Number of bighorn sheep observed on aerial surveys from 2000-2006 in GMUs 41W, 44BS, and 45ABC.

Year	Unit	<u>CLI</u>	<u>CLII</u>	<u>CLIII</u>	<u>CLIV</u>	<u>Total Rams</u>	<u>Ewes</u>	<u>Lambs</u>	<u>Yearlings</u>	<u>Totals</u>
2000	41W	1	7	5	2	15	34	5	5	59
2003	41W	2	6	7	3	18	41	9	2	70
2006	41W	0	10	10	1	21	32	6	4	63
2002	44BS	5	8	8	4	25	37	9	4	75
2003	44BS	1	6	4	1	12	23	6	4	45
2005	44BS	1	5	5	0	11	26	7	1	45
2000	45A	14	27	15	6	62	115	22	13	212
2003	45A	4	13	12	4	33	90	13	9	146
2006	45A	1	11	17	4	33	51	14	4	102
2000	45B	5	15	13	10	43	53	12	12	122
2003	45B	1	7	6	2	16	51	11	10	88
2006	45B	1	6	6	0	13	39	7	5	64
2000	45C	5	11	16	8	40	73	13	9	135
2003	45C	7	6	12	11	36	59	19	9	123
2006	45C	3	8	15	3	29	35	10	7	81

Appendix 5. Kofa Group Size Estimator Model used to determine bighorn sheep population numbers and harvest permit numbers.

The goal of the survey program for bighorn sheep is to obtain absolute size estimates for all populations in the Region. The number of hunting permits issued is based on the actual number of mature males in the population. Estimates previously were calculated using a simultaneous double count estimator as described by Graham and Bell (JWM:1989 54(4):1009-1016). Region IV completed a study entitled "Sighting Rates of Bighorn Sheep during Helicopter Surveys on the Kofa National Wildlife Refuge" (Arizona Game Investigations 1996-97). From this study department personnel derived a new estimator to calculate bighorn population estimates. It uses different observation rates (to correct for visibility bias) for different group sizes of surveyed sheep. It tends to be somewhat more conservative than our earlier estimation procedure.

Regional biologists and wildlife managers conduct surveys using a methodology developed to ensure a systematic approach to estimating populations of bighorn sheep. The same method is applied to all of the Region's bighorn populations. The use of this method minimizes survey effort and produces estimates of bighorn numbers and sex-age ratios. Because of budget and time constraints, surveys are conducted only once every three years.

Surveys will be conducted using the sampling methodology outlined in "Surveying Bighorn Sheep" (Remington and Welsh 1993, in The Desert Bighorn Sheep in Arizona, edited by R.Lee). Helicopters will be used to do complete surveys of selected sample blocks.

Permit recommendation should be based on the calculation worksheet. Fill it out as follows:

1. Fill in the table using the survey numbers for the past 3 years. In most cases there will have been only 1 survey during that time. If the whole area was not surveyed, then extrapolate the survey numbers to the whole area before putting them in the table (only do this extrapolation if a substantial portion of known occupied habitat was not surveyed).
2. Calculate means for the past 3 years (not past 3 surveys).
3. Calculate a population estimate using the "Kofa Group Size Estimator". The formula for this is:

$$\text{Total Pop.} = (\text{Number of groups of size } 1/0.433 \times 1) + (\text{groups of size } 2/0.507 \times 2) + (\text{groups of } 3/0.581 \times 3) + (\text{gps of } 4/0.654 \times 4) + (\text{gps of } 5/0.728 \times 5) + (\text{gps. of } 6/0.802 \times 6) + (\text{gps of } 7/0.875 \times 7) + \dots(\text{gps of } n/0.949 \times n)$$

This gives a total population estimate. Use the ratios of the different classes of sheep in the survey data to calculate the portion of the total population for each of the sheep classes.

4. Calculate permit numbers. The permit recommendation should be based on 20% of estimated class 3 and 4 rams. We generally do not round the permit number up unless we have reason to (such as a large cohort of class 2 rams).

Use the "Management Recommendations & Notes" page to describe the surveys, the methodologies used, and anything else that may be relevant to your permit recommendation.

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